

# **Review of the California Ambient Air Quality Standard for Nitrogen Dioxide**

**May 8, 2006**

**Sacramento, California**



**Air Resources Board**



**Office of Environmental  
Health Hazard Assessment**

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**California Environmental Protection Agency**

# Overview

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- Why are we reviewing the State Nitrogen Dioxide (NO<sub>2</sub>) standard?
- What are the regulatory steps in a standard review?
- What are the health effects of NO<sub>2</sub>?
- What is the draft recommendation for revising the NO<sub>2</sub> standard?
- What is the health basis of the recommendation?

# Why Are We Reviewing the State NO<sub>2</sub> Standard?

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- Protect public health
- Comply with State law
- Address requirements of Children's Environmental Health Protection Act (SB25, Escutia, 1999)

# Results of 2000 AAQS Prioritization Process

Priority Pollutant	Review Schedule
PM10 (including sulfates)	2002
Ozone	2005
Nitrogen dioxide	2006

Adapted from Staff Report Entitled “Adequacy of CA Ambient Air Quality Standards: Children’s Environmental Health Protection Act,” December 2000.

# Current NO<sub>2</sub> Standards (ppm)

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One Hour

Annual

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California

0.25

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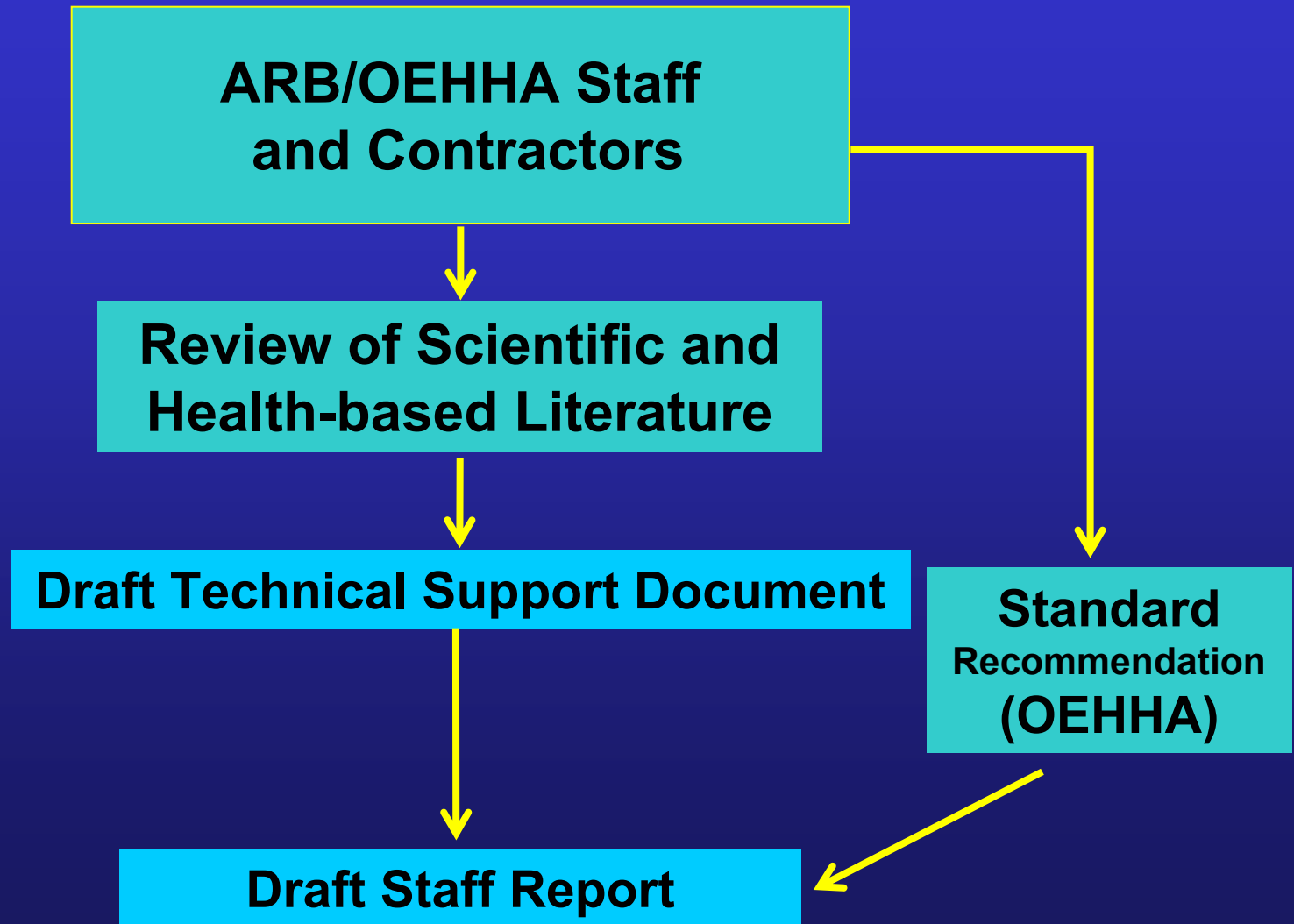
US EPA

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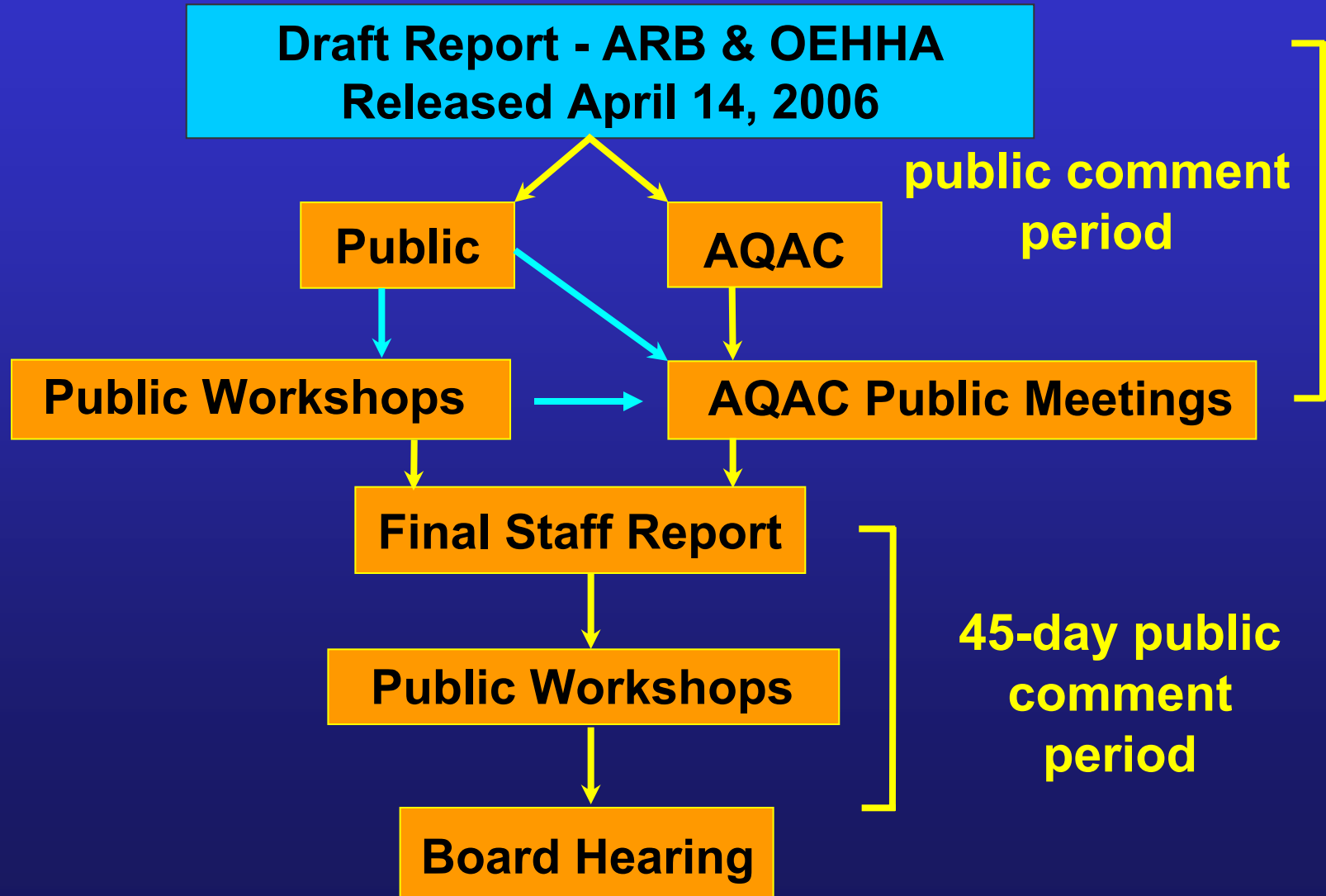
0.053

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# What Are the Regulatory Steps in a Standard Review?



# What Are the Regulatory Steps in a Standard Review?



# What Are the Elements of an Ambient Air Quality Standard?

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- Air Quality Standard: legal definition of clean air
- Standards have:
  - Pollutant definition
  - Concentration
  - Averaging time
  - Monitoring Method

# Standard Setting Does Not Include

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- Attainment designation
- Feasibility of controls
- Cost of controls
- Implementation of controls

# Why Are We Concerned about NO<sub>2</sub>?

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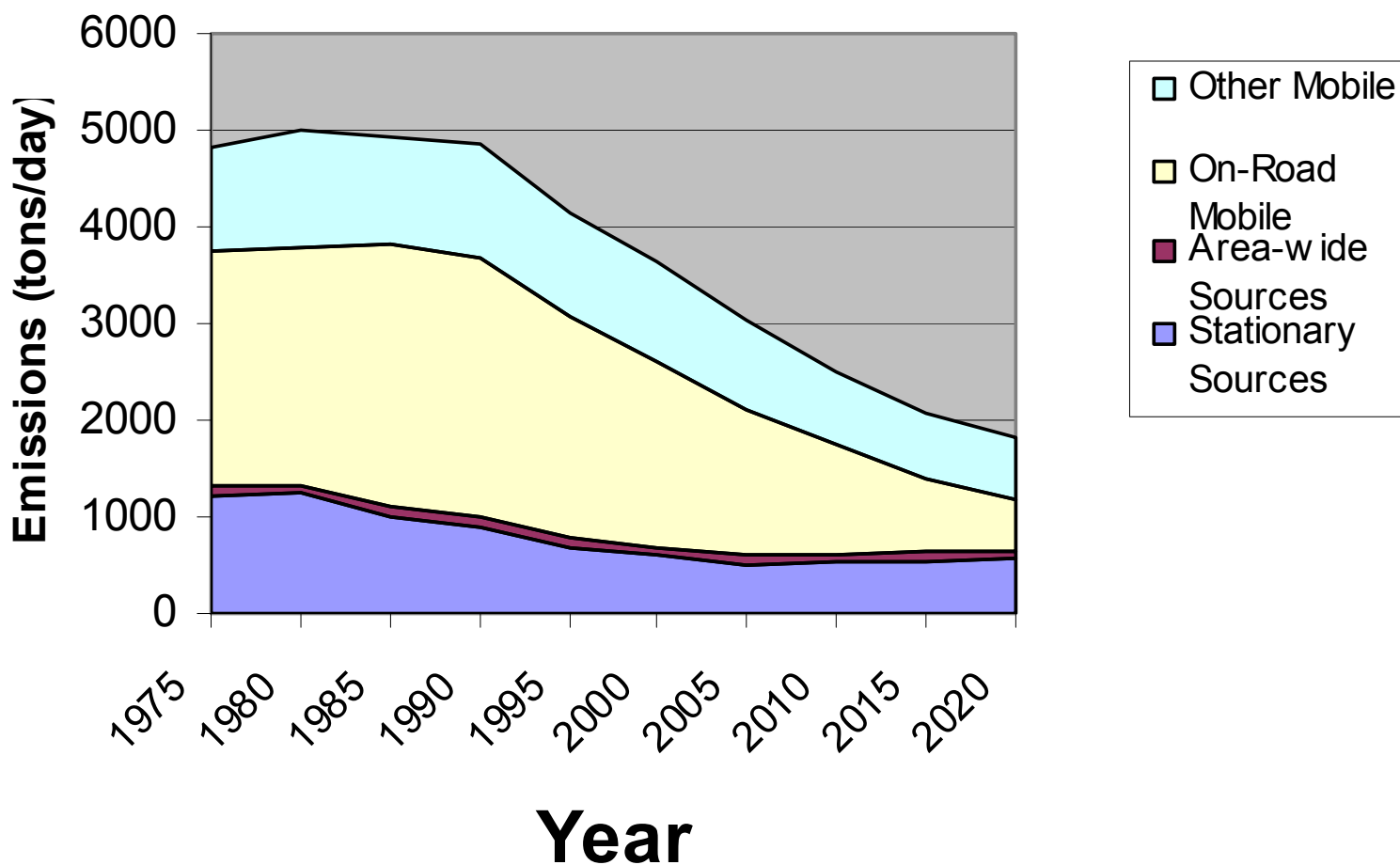
- Based on the priority review under the Children's Environmental Health Protection Act
- Current standard may not adequately protect public health, including the health of infants and children
- NO<sub>2</sub> commonly found pollutant in outdoor air

# Sources and Levels

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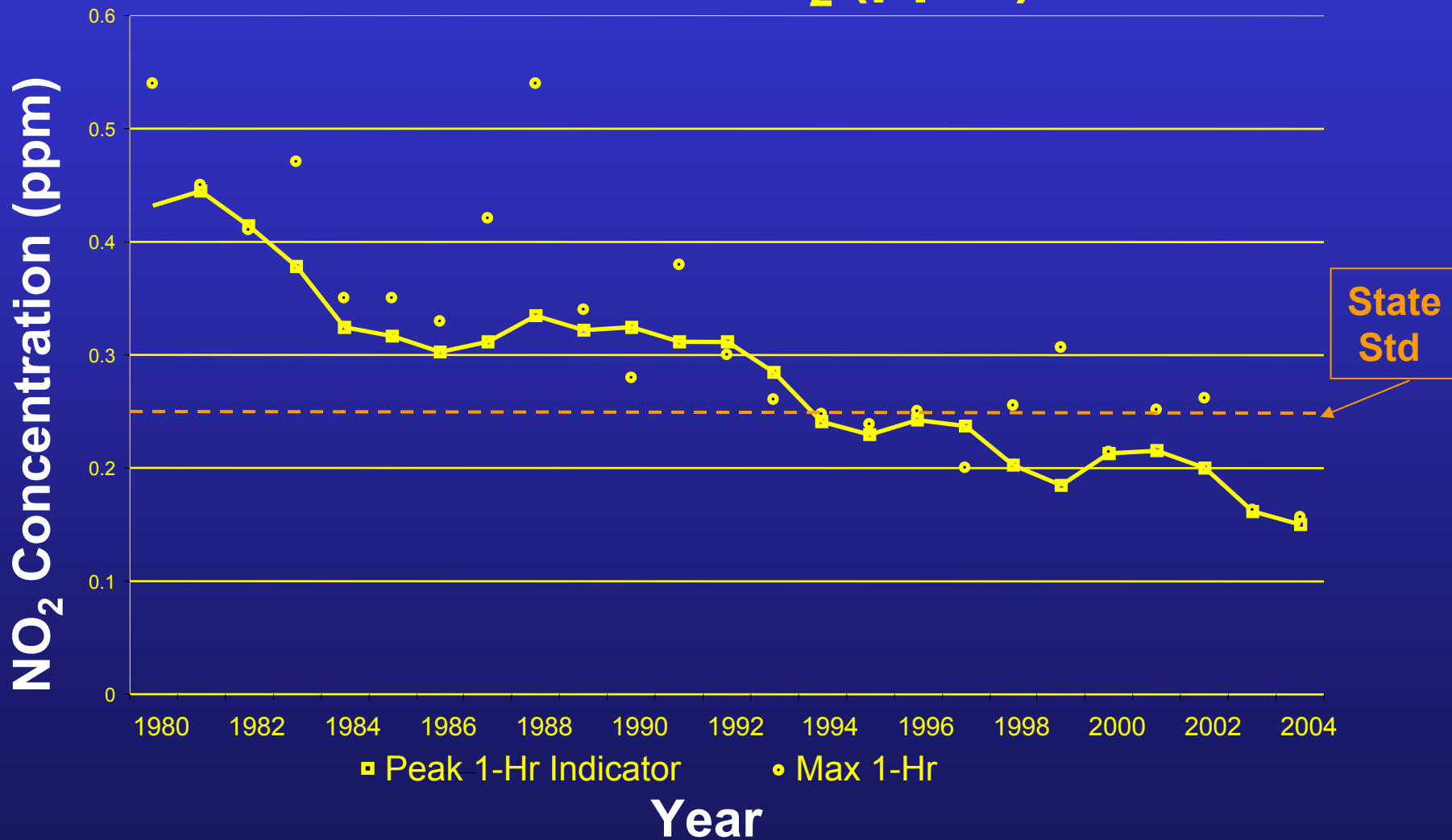
- An outdoor and indoor pollutant
- Product of combustion sources
- Also produced from nitric oxide (NO), a product of combustion, and reactive hydrocarbons

## Oxides of Nitrogen Emission Trends (tons/day) Statewide Annual Average



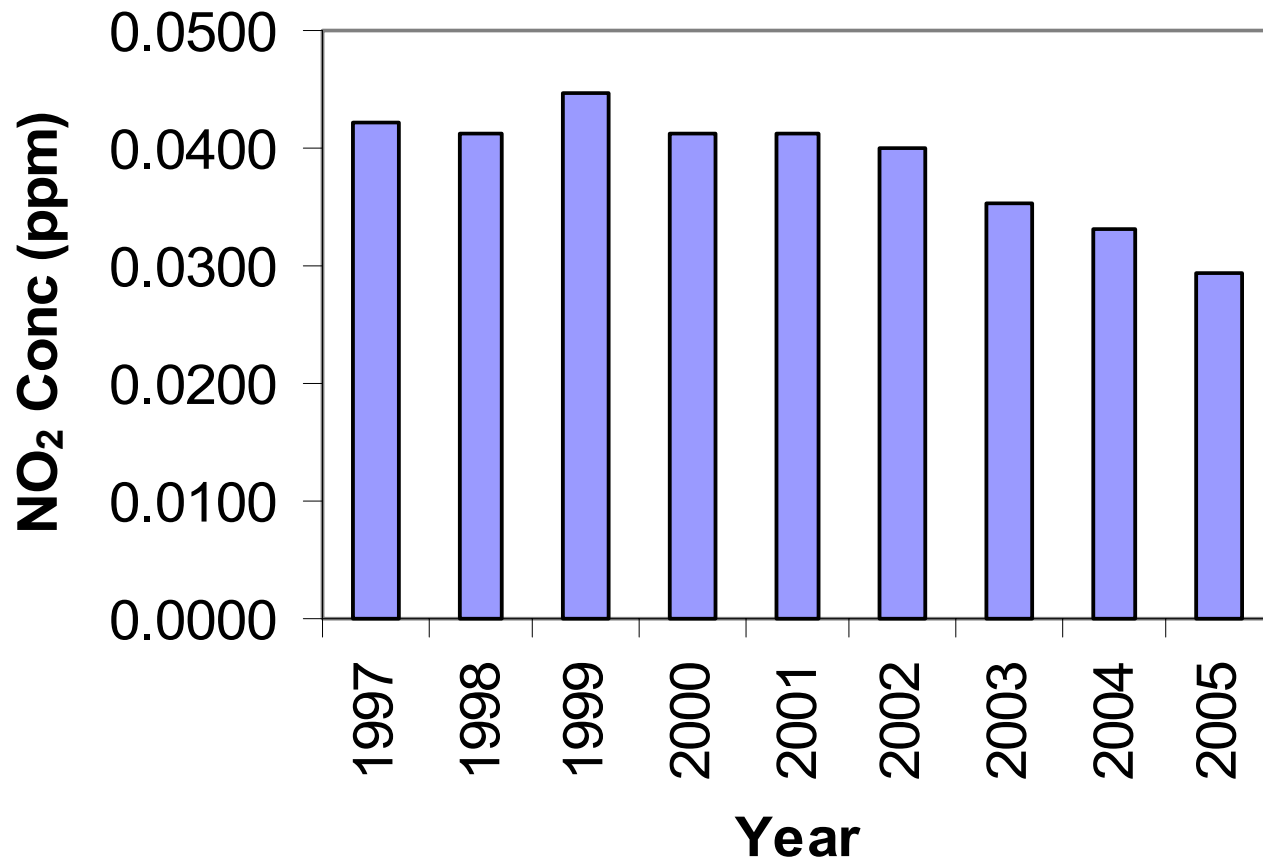
# South Coast Air Quality Trends

## One-hour NO<sub>2</sub> (ppm)



# South Coast Air Quality Trends

## Annual Average NO<sub>2</sub> Concentration (ppm)



# **OEHHA Recommendation to Revise the California Nitrogen Dioxide Standard**

- Retain Nitrogen Dioxide as the pollutant definition
- Lower the current 1-hr standard of 0.25 ppm, to 0.18 ppm, not to be exceeded
- Establish a new annual average standard of 0.030 ppm, not to be exceeded
- Retain the chemiluminescence monitoring method

# Existing Standards and Recommendations

Averaging time	CA (1992)	Federal (1995)	OEHHA Rec
1-hour	0.25 ppm (470 $\mu\text{g}/\text{m}^3$ )	--	0.18 ppm
Annual average	--	0.053 ppm (100 $\mu\text{g}/\text{m}^3$ )	0.030 ppm

# **Evidence on the Health Effects of Nitrogen Dioxide Provided from Different Types of Studies**

- Controlled human exposure
- Animal toxicology
- Epidemiology

# Controlled Human Exposure Studies

- Exposures of human volunteers in a laboratory setting
- Responses studied: respiratory symptoms, lung function, inflammation (lung or blood), cardiovascular effects
- Typical subjects: healthy adults or mild asthmatics

# Controlled Human Exposure Studies

- Advantages
  - precise measures of exposure and response
- Limitations
  - few studies on more vulnerable populations
  - small sample size and studied doses
  - few studies of pollutant mixtures
  - cannot predict effects of chronic exposures

# **Controlled Human Studies of NO<sub>2</sub>: Lowest Concentrations Showing Effects**

- Healthy Subjects: no effects below 1 ppm
- Asthmatics
  - increased airway reactivity at 0.2 – 0.3 ppm (30 min-2 hr)
  - enhanced airway response to allergen at 0.26 ppm (15-30 min)
  - potential to increase asthma symptoms

# Controlled Human Studies (cont.):

- Subjects with chronic lung disease
  - Decreased lung function at 0.3 ppm
- Limited data for children, elderly and those with cardiovascular disease
- Other considerations:
  - Increased airway reactivity with  $\text{SO}_2 + \text{NO}_2$ ?
  - Variability in response?
  - Effects at longer durations?

# Findings From Animal Studies

- Prolonged repeated exposure of young animals during lung development show changes in lung structure
- In animal models of allergic asthma, exposure to high concentrations of NO<sub>2</sub> produce increased markers of allergic inflammation
- Animal studies support lung toxicity

# Epidemiologic Studies

- Advantages

- Evaluate exposures and responses of free-living populations over a wide range of individuals, behaviors, and subgroups, including susceptible individuals
- Examine both short and long-term exposures

- Limitations

- Difficult to determine relevant exposure averaging time
- Need to account for other factors such as co-pollutants

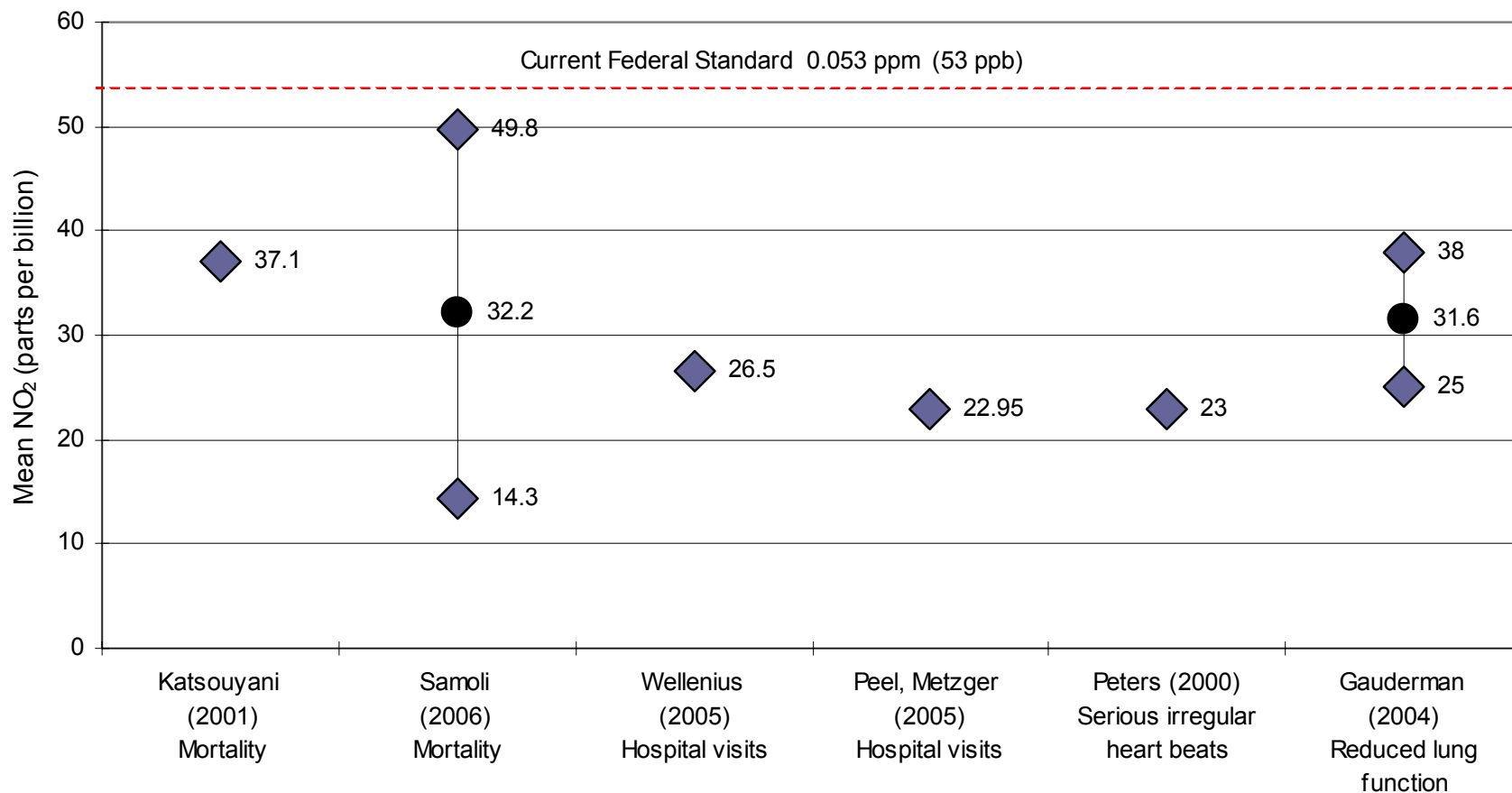
# Findings From Epi Studies

- Outdoor studies short term exposure (24-hr to several days)
  - Associations reported for mortality, hospital admissions and ER visits, cardiac arrhythmias.
  - Respiratory effects most consistent: both adults and children.
- Outdoor studies (including traffic) long term exposure (months to years)
  - Asthma exacerbations
  - Reduced lung function and lung growth
  - Low birth weight
  - Respiratory symptoms

# Findings From Epi Studies (cont.)

- Indoor studies long term exposure (weeks to months): (gas stoves and measured NO<sub>2</sub>):
  - Respiratory symptoms among asthmatics and infants at risk of asthma

# Key epidemiologic studies showing an effect of NO<sub>2</sub>: mortality and morbidity



◆ = Average NO<sub>2</sub> in single city study

◆ = Range of averages in multi-city study

● = Overall average NO<sub>2</sub> in multi-city study

# Basis for OEHHA Recommendations

# **SB 25 Requires Special Considerations for Infants and Children**

1. Exposure patterns: higher exposures per body weight and more time spent outdoors
2. Susceptibility: exposure may impact lung development and function
3. Interactions: possible enhanced NO<sub>2</sub> effect with SO<sub>2</sub> (chamber studies) and with PM<sub>10</sub> (epi studies)

# **Basis for OEHHA NO<sub>2</sub> 1-hr standard of 0.18 ppm**

1. Includes additional studies since last review in 1992
2. Increased airway reactivity in asthmatics at 0.2 –0.3 ppm 30 min-2 hr
3. Enhanced allergic response in asthmatics at 0.26 ppm for 15-30 min

# Basis for NO<sub>2</sub> 1-hr standard (cont.)

## 4. Add margin of safety for:

- Children and other susceptible populations (e.g. more severe asthmatics)
- Possible effects at lower concentrations
- Proposing 1-hr avg standard but effects observed after 15-30 minutes
- Some of the effects observed in short-term epi studies may be due to 1-hr peaks

# **Basis for OEHHA Annual average Standard of 0.030 ppm**

1. Potential effects of NO<sub>2</sub> on serious outcomes including mortality, ER, hospitalization with long term averages of 0.025 - 0.035 ppm
2. Children's Health study found decreased lung function growth in areas with annual averages of 0.030 to 0.040 ppm

## **Basis for Annual average (cont.)**

3. Important to lower full distribution not just peak 1-hr

  - Tox shows alterations in lung structure in young animals due to long term exposures

# **Summary**

## **OEHHA Recommendation for Nitrogen Dioxide**

- Retain Nitrogen Dioxide as the pollutant definition
- Decrease the current 1-hr standard to 0.18 ppm, not to be exceeded
- Establish a new annual average of 0.030 ppm, not to be exceeded
- Retain the chemiluminescence monitoring method

# Timeline for NO<sub>2</sub> Review

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April 14th	Release of Draft Report
May 8, 11th	Public Workshops
May 31 <sup>st</sup>	Public Comments Due
June 12-13	AQAC Meeting
July	Public Comments
October, 2006	Final recommendations to Board (tentative)

# Contact Information

- Nitrogen Dioxide standard review website:  
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